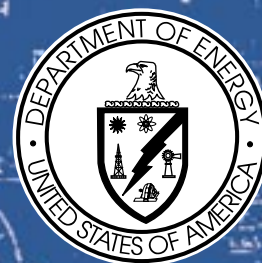


Greening Federal Facilities

*An Energy, Environmental, and Economic Resource Guide
for Federal Facility Managers*



Iconography



Technical Information



Rules of Thumb or Tip



Good Idea



Operations and Maintenance



Financial, Economic, or Life Cycle



Cautionary Note



Environmental Issues



Recycling Information



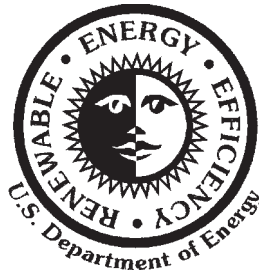
Examples

Greening Federal Facilities:

An Energy, Environmental, and Economic Resource Guide for Federal Facilities Managers

“Then I say the earth belongs to each...generation during its course, fully and in its own right, no generation can contract debts greater than may be paid during the course of its own existence.”

Thomas Jefferson, September 6, 1789



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About the Contributing Organizations

The U. S. Department of Energy

The U.S. Department of Energy (DOE) contributes to the welfare of the Nation by providing resources to achieve efficiency in energy use, diversity of energy sources, a more productive and competitive economy, improved environmental quality, and a secure national defense. DOE provides scientific and technical information, and educational resources to Federal agencies and the public.

Office of Energy Efficiency and Renewable Energy

DOE's Office of Energy Efficiency and Renewable Energy leads the Nation to a stronger economy, a cleaner environment, and a more secure future through the development and deployment of sustainable energy technology.

The Federal Energy Management Program

The Federal Energy Management Program (FEMP) reduces the cost of government by advancing energy efficiency, water conservation, and the use of solar and other renewable energy. FEMP accomplishes its mission by creating partnerships, leveraging resources, transferring technology and providing training and support. Each of these activities is directly related to achieving not only the goals set forth in law, Energy Policy Act of 1992 and Executive Order No. 12902, but also those which are inherent in sound management of Federal financial and personnel resources.

Greening America

Greening America is a nonprofit foundation that educates the public and private sectors about energy efficient and environmentally sound design, innovation, and technology. Greening America, which had its genesis in the Greening of the White House, produces videos, publications, on-line technical resources, and other materials that show practical examples of how sound energy and environmental decision-making makes good economic sense.

Sustainable Systems, Inc.

Sustainable Systems, Inc. is a consulting firm that is dedicated to implementing the principles of sustainability in development. Multi-disciplinary teams of technical professionals, social scientists, economists, and business administrators address problems—from community development to technological issues—from the viewpoint of minimizing the resource and environmental impacts of the activities of its clients, without compromising quality of life.

Disclaimer

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Executive Summary

In his 1993 Earth Day address, President Bill Clinton made a commitment to make the White House a model for energy efficiency and waste reduction. He called for an energy and environmental upgrade and retrofit of the White House complex, and said:

“For as long as I live and work in the White House, I want Americans to see it not only as a symbol of clean government, but also a clean environment. We’re going to identify what it takes to make the White House a model for efficiency and waste reduction. And then we’re going to get the job done. I want to make the White House a model for other federal agencies, for state and local governments, for businesses, and for families in their homes.”

The actions that resulted from the President's request came to be known as *The Greening of the White House*.

The Federal Energy Management Program (FEMP) is the lead federal agency for helping transfer the energy and environmental technologies used in *The Greening of the White House* to all Federal buildings. Through this effort FEMP is working toward fulfillment of Executive Order 12902 to reduce Federal energy consumption by 30% between 1985 and 2005.

Greening Federal Facilities is a nuts-and-bolts resource guide compiled to increase energy and resource efficiency, cut waste, and improve the performance of Federal buildings and facilities. The guide highlights practical actions that facility managers, design and construct staff, and facility planners can take to save energy and money, improve the comfort and productivity of employees, and benefit the environment. It is another step in a national effort to promote energy and environmental efficiency in the nation's 500,000 Federal buildings and facilities.

Greening Federal Facilities encompasses actions ranging from improved landscaping, to materials selection, to recycling, to water conservation, to energy-efficient lighting, heating and cooling. It highlights best practices to:

- invest in improvements that have quick paybacks and make economic sense;
- increase productivity, comfort, and health of employees and building occupants;
- maximize innovative financing and partnering opportunities;
- facilitate interagency cooperation;
- work within the ongoing operations and procedures of facilities management staff; and reduce environmental impacts.

To develop and review *Greening Federal Facilities*, FEMP, with support from Greening America, assembled an inter-agency team consisting of experts within DOE, DOD, GSA, EPA, the Office of the Federal Environmental Executive, and many other Federal agencies. It also brought together an expert team from DOE Labs, including Lawrence Berkeley National Laboratory (LBNL), Pacific Northwest National Laboratory (PNNL), and the National Renewable Energy Laboratory (NREL). A special advisory group also included a 30-member team comprised of many of the nation's leading private-sector experts in architecture, engineering, building operations, and energy and environmental management.

Greening Federal Facilities reflects a long-standing commitment to make government work better and cost less, to use the Federal government's enormous purchasing power to stimulate markets for American energy and environmental technologies, and to save taxpayers money through reduced material costs, waste disposal costs, and utility bills.

Greening Federal Facilities is a resource guide for Federal facility managers to assist them in reducing energy consumption and costs, improving the working environment of the facilities they manage, and reducing the environmental impacts of their operations. Showcase initiatives such as *The Greening of the White House* serve as models for initiating environmental and energy upgrades for Federal facilities.

Sustainability is a term that covers the wide range of actions needed to reduce the impact of the built environment on the natural environment and, with respect to this guide, is synonymous with "greening". At its very heart, sustainability is about leaving a high quality of life for this nation's many future generations. For our society to be sustainable we must (1) use all resources (energy, water, material, and land) efficiently and minimize waste; (2) protect the natural environment, the source of all our resources; and, (3) create a healthy built environment for future generations. This guide concentrates on sustainable building actions that are practical and cost-effective.

This guide was developed by the Federal Energy Management Program (FEMP) and places key energy and environmental information along with appropriate economic data at the fingertips of the facility manager to assist the decision-making process. The guide is intended to provide a quick introduction and reference to the many technologies and practices involved in greening efforts. It suggests actions that are likely to be successful as first steps in saving energy, water, and resources. Each section is condensed, and identifies additional resources for facility managers to consult for detailed information. The reader is encouraged to consult these resources and the on-line version of this guide that has even more resources available to the user. Section 1.3 is a tour of this guide and shows facility managers how to effectively use it to "green" their operations. *Greening Federal Facilities* emphasizes preventing waste and pollution instead of focusing on the compliance process.



Issues

So who are these facility managers and why are they important? Facility managers are the people who manage several hundred thousand facilities worldwide on behalf of the United States. They can be in-house energy managers, solid waste managers or others with similar responsibilities. In DOD they are the Base Civil Engineers (BCE) and Directors of Engineering and Housing (DEH). They are middle-level managers with huge responsibilities and declining human and financial resources. Some facility manager facts for consideration:

- 1** The Federal facility manager community operates and maintains over 500,000 buildings owned and leased by the Federal Government!
- 2** The area of these buildings is in excess of 3,100,000,000 (3.1 billion) square feet of floor space.
- 3** These buildings are the homes, working places, and support systems for almost two million Federal workers and many contract staff. They comprise everything from office buildings to power plants, and include aircraft hangers, libraries, hospitals, tourist attractions, and prisons.
- 4** These Federal buildings consume in excess of 60,000,000,000 kilowatt-hours of energy each year. This energy costs more than \$3.5 billion each year.
- 5** The water utilized by these buildings and other facilities is staggering in quantity—several hundred cubic miles each year!
- 6** Facility managers purchase billions of dollars of materials annually for operations, maintenance, repair, and renovation. Their procurement decisions dramatically affect the types of products created and manufactured by a wide range of businesses, from paper products to steel panels, from

cleaning fluids to hydraulic fluids, from medicines to pesticides.

The bottom line is this: Facility managers probably manage more resources and have more impact on the environment than any other group in the world. Entire changes in direction relative to energy and environmental quality are possible through their collective action. This guide is designed to provide facility managers with the information needed to make wise energy and environmental decisions that not only reduce energy consumption and protect the environment, but also save money and improve the productivity of Federal workers.

Did you know? The cost of operating an average Federal building, including the amortized construction cost, is about \$15 per square foot annually. The cost of the Federal government employees in these buildings is on the order of \$315 per square foot each year! The meaning of this factor of 20 difference between building and occupant costs is clear. If you increase the productivity of the work force by a mere 5% by improving the working environment, the resulting annual savings will exceed the annual cost of building ownership and operation!! This guide shows facility managers how to make these positive changes, save energy, increase productivity, and greatly reduce facility environmental impacts.

What are the potential savings that facility managers can produce to both reduce costs and U.S. dependence on foreign energy sources? The Electric Power Research Institute (EPRI) estimates an aggressive drive to reduce energy costs can reduce electricity use by 24% to 44%. The Rocky Mountain Institute goes even further and claims potential cost-effective electricity savings of 75%.

Cost of Building/Year:	\$15/sq ft
Employee Cost/Year:	\$315/sq ft
5% Productivity Improvement:	\$16/sq ft
10% Productivity Improvement:	\$31/sq ft

The key principles for facility managers to follow to reduce energy and environmental impacts of their operations are:

- 1 Reduce resource consumption:** energy, water, land.
- 2 Reduce resource waste:** energy, water, materials.
- 3 Increase equipment and system efficiency:** no-cost or low-cost tune-ups, modifications, replacement.
- 4 Emphasize source and waste reduction** to all facility users.
- 5 Create healthy environments** for Federal workers: air, light, noise, temperature, humidity.

Contacts

Federal greening initiatives, including the on-line version of this guide and The Greening of the White House, are located on the internet at <http://www.eren.doe.gov/femp/greening.html>.

The FEMP Help Desk at (800) DOE-EREC offers technical support on a wide range of topics to assist facility managers in greening their facilities.

There is a wide variety of Federal laws, Executive Orders, and Executive Memoranda that facility managers are required to follow to reduce the energy and environmental impacts of the buildings they manage. These laws and regulations already direct facility managers to be proactive in their efforts to reduce resource consumption, reuse and recycle materials, and dramatically reduce the impacts of Federal government activities on the environment. Although they are required to comply with the many specific directives in these documents, many facility managers may be unaware of the actions they can take with regard to implementation. In this section, the major Federal regulations governing energy and environmental actions, together with their important provisions, are listed in chronological order.



Federal Laws & Executive Orders

1 Energy Policy and Conservation Act (EPCA) of 1975. EPCA was the first major piece of legislation to address Federal energy management. This law directed the President to develop a comprehensive energy management plan. EPCA has largely been overtaken by later legislation.

2 Resource Conservation and Recovery Act (RCRA) of 1976. RCRA §6002 established a Federal mandate to “Buy Recycled.” RCRA §1008 and §6004 require all Federal agencies generating solid waste to take action to recover it.

3 National Energy Conservation Policy Act (NECPA) of 1978. NECPA specified the use of a life-cycle costing methodology as the basis for energy procurement policy and specified the rate for retrofit of Federal buildings with cost-effective energy measures. Title V of NECPA was codified as the Federal Energy Initiative.

4 Comprehensive Omnibus Budget Reconciliation Act (COBRA) of 1985. COBRA, a one-year funding bill, provided Federal agencies with

an alternative source of funding for energy-efficiency investments. For the first time, agencies were encouraged to seek private financing and implementation of energy-efficiency projects through “shared energy savings” (SES) contracts.

5 Federal Energy Management Improvement Act (FEMIA) of 1988. It mandated a 10% reduction in per-square-foot energy use by Federal buildings between 1985 and 1995, marking the first time that Congress specified the level of savings that had to be achieved.

6 Executive Order 12759, “Federal Energy Management,” April 17, 1991. This Order extended the FEMIA energy reduction requirements for Federal buildings to 2000, requiring a 20% reduction in per-square-foot energy usage from 1985 levels. This executive order was replaced by Executive Order 12902 (number 13, next page).

7 Energy Policy Act of 1992 (EPACT). This Act increases conservation and energy-efficiency requirements for government and consumers; for Federal agencies, requires a 20% reduction in per-square-foot energy consumption by 2000 compared to a 1985 baseline; provides authorization for DOE to issue rules and guidance on Energy Savings Performance Contracts (ESPCs) for Federal agencies; requires Federal agencies to train and utilize energy managers; directs the Office of Management and Budget to issue guidelines for accurate assessment of energy consumption by Federal buildings; and directs GSA to report annually on estimated energy costs for leased space.

8 Executive Order 12843, “Procurement Requirements and Policies for Federal Agencies for Ozone-Depleting Substances,” April 21, 1993, requires Federal agencies to maximize the use of safe alternatives to ozone-depleting substances by: (1) revising procurement practices; (2) modifying specifications and contracts that require the use of ozone-depleting substances; (3) substituting non-ozone-depleting substances to the extent economically practicable; and (4) disseminating informa-

tion on successful efforts to phase out ozone-depleting substances.

9 **Executive Order 12844**, “Federal Use of Alternative Fueled Vehicles,” April 21, 1993. This requires the Federal government to adopt aggressive plans to acquire, subject to availability of funds and considering life-cycle costs, alternative fueled vehicles, in numbers that exceed by 50% the requirements for 1993 through 1995, set forth in the Energy Policy Act of 1992.

10 **Executive Order 12845**, “Requiring Agencies to Purchase Energy-Efficient Computer Equipment,” April 21, 1993. Order 12845 requires all acquisitions of microcomputers, monitors, and printers to meet EPA Energy Star requirements for energy efficiency, including low power standby features as defined by EPA Energy Star Standards. Agencies must make Federal users aware of the economic and environmental benefits of energy saving equipment through information and training classes.

11 **Executive Order 12856**, “Federal Compliance with Right-to-Know Laws and Pollution Prevention Requirements,” August 4, 1993. Explains how Federal agencies are to comply with Emergency Planning and Community Right-to-Know (EPCRA) reporting requirements and offers “leadership options” for Federal agencies in meeting the goals of the Order.

12 **Executive Order 12873**, “Federal Acquisition, Recycling, and Waste Prevention,” October 20, 1993. This Executive Order addresses the government’s purchasing power, incorporates environmental considerations into decision making, and encourages waste prevention and recycling in daily operations. Federal agencies: (1) must set goals for waste reduction; (2) must increase the procurement of recycled and other environmentally preferable products; and, (3) can retain some of the proceeds from the sale of materials from recycling or waste-prevention programs.

13 **Executive Order 12902**, “Energy Efficiency and Water Conservation at Federal Facilities,” March 8, 1994. For Federal agencies it requires: (1) a 30% reduction in per gross square foot ener-

gy consumption by 2005 compared to 1985 to the extent that these measures are cost effective; (2) a 20% energy efficiency increase in industrial facilities by 2005 compared to 1990 to the extent that these measures are cost effective; (3) the implementation of all cost-effective water conservation projects; and, (4) the procurement of products in the top 25% of their class in energy efficiency where cost-effective and where they meet the agency’s performance requirements. In addition to available appropriations, agencies shall utilize innovative financing and contracting mechanisms including, but not limited to, utility DSM and ESPCs to meet the goals and requirements of EPACT and this order.

14 **Executive Memorandum** on “Environmentally and Economically Beneficial Practices on Federal Landscaped Grounds,” April 26, 1994. This requires Federal grounds and Federally funded projects, where cost-effective and practicable, to use regionally native plants for landscaping. It also requires facility managers to promote construction practices that minimize adverse effects on the natural habitat; minimize use of fertilizers and pesticides; use integrated pest management techniques; and, recycle green waste. Water-efficient practices, such as minimizing runoff, using mulches, irrigating using efficient systems, and performing water audits, are also required. Agencies must also establish areas that demonstrate these principles.

15 **10CFR435** establishes performance standards to be used in the design of new Federal commercial and multifamily high rise buildings. Some of the guidelines are relevant to retrofits.

16 **10CFR436** establishes procedures for determining the life-cycle cost effectiveness of energy conservation measures, and for prioritizing energy conservation measures in retrofits of existing Federal buildings.

Contacts

For more information on Federal rules and regulations relative to energy and environmental actions, contact FEMP’s Help Desk at (800) DOE-EREC.

This section describes how this guide is organized to deliver key decision-making information to the facility manager as effectively as possible.



How this guide is particularly useful to facility managers

Greening Federal Facilities uses “Action Moments” as the focal points for assisting facility managers in making changes that will “green” their operations. An Action Moment is a point in time when there is an opportunity to make major positive changes in facility operations that will reduce environmental and energy impacts. A good example of an Action Moment is roof repairs. The need to replace a roof presents opportunities to improve insulation, install skylights to provide daylighting, and improve the Indoor Environmental Quality (IEQ) of interior spaces beneath the roof.



Guide Organization

The guide is organized into three separate parts:

Part I—Introduction, simply defines the playing field for facility managers and suggests ways to pay appropriate attention to energy and environmental issues. It also contains a section on decision-making tools a facility manager can use to make difficult and sometimes expensive decisions in an era of personnel and resource reductions.

Part II—Energy/Environmental Decision Making, is the technical part of the guide and provides guidance on how to reduce energy, water, and other resource consumption. It quickly highlights the issues, provides solutions, shows success stories related to the subject at hand, and points to sources of further information.

Part III—Opportunities For Change, gets to the heart of the facility manager's job and suggests ways to use the information in Parts I and II

on a daily basis. Part III provides the facility manager with approaches that can be used during operations and maintenance where the energy and environmental impacts are significant. Again, success stories in the form of brief examples are used to provide real world examples of how appropriate changes can be successfully made.



Icons

The guide is organized with the help of icons to rapidly direct the facility manager to the most useful information. These icons are used as the situation dictates, and are reasonably self-explanatory. Note that all icons are listed on the inside of the front cover for ready reference.



Technical Information



Rule of Thumb or Tip



Good Idea



Operations and Maintenance



Financial, Economic, or Life Cycle



Cautionary Note



Environmental Information



Recycling Information



Examples

Examples are used to show concrete instances of exactly how the particular ideas for lower environmental and energy impacts can be used. The example designated by the file folder icon is a short summary of a very specific application.

References in the hard copy version of this guide are limited due to space. Please visit our on-line web site under “Greening Initiatives” at <http://www.eren.doe.gov/femp>.

Many of the decisions required of the facility manager with respect to energy or environmental actions require a logical, step-by-step analysis of the available options. This rigorous analysis complements other steps in the decision-making process, such as identifying the problem, working with affected parties to develop options, selling the idea to decision makers, developing a funding package, and getting buy-in from affected building users.

The analysis method used should take into account all the major criteria, appropriately weight the criteria depending on their relative importance, and rank each of the options relative to each criterion. The preferable result is a set of scores that can be used as a basis for selecting one of the available options. Although there are many decision-making techniques, the method described here, the Criteria Weighting Method (CWM), is one the facility manager can easily utilize and apply to help make relatively complex decisions in a fairly logical and rigorous manner.



Technical Information

The first step in decision-making is to list the available options. All possible options should be listed as an exercise in ensuring completeness. Only the top options need be carried forward into the formal decision-making process.

Note that one of the options can be “Do Nothing!”

After listing the available options the criteria relative to the situation should be listed. Some of the criteria that can be chosen are: quality, life-cycle cost, durability, performance, appearance, availability, weight, physical size, safety, reliability, noise levels, conformance with building codes, color, aesthetics, weather resistance, U.S. manufacturer, and subcontractor performance.

Note that life-cycle cost must be included as one of the criteria for each option. It is assumed that the life-cycle cost has been determined prior to the final decision-making process.

The process described here places the options on the horizontal axis of a decision matrix and the cri-

teria on the vertical axis. The first step in the process is to determine the relative weights of the various criteria. This determination is accomplished by a pair-wise comparison of the criteria to establish which of the two criteria is more important. When this process has been completed, the weights are calculated and written into the matrix. The various options can then be ranked for each criterion and the final scores computed.

The use of this decision-making technique is described below.



Criteria Weighting Method

Instructions: The first step in the Criteria Weighting Method (CWM) is to develop the Criteria Weights. Once the weights are determined, they are applied to the problem at hand. Two simple matrices are used to assist this process as described below: the Criteria Matrix and the Analysis Matrix.



Developing Criteria Weights: (1) On the left side of the following page is an example Criteria Matrix used to determine weights for a sample decision on exterior wall types. The process begins with “Cost” (Criterion A) being compared to “Maintainability” (Criterion B), and the more important of the two is placed in the box along with the preference weight for the more important. In this case Cost is the more important and there is a *minor difference* which has a weight of 1. Consequently “A1” is entered in the box at the intersection of these two criteria. Comparing Cost (A) with Redesign Time (F), the more important is Cost and the difference is between *major* and *medium*, a weight of 4. “A4” is entered in the intersection of the two criteria. (2) Continue this process to complete the pair-wise comparison of all criteria. (3) At the end of the comparison add the weight factors for each criterion both horizontally and vertically and write the total by each criterion on the right. In this case, Cost (A) has a total weight of 13 and Proven Quality (D) has a total of 9. The rank is written in the right column based on these totals.

2 Applying the Criteria Weights: (1) Below right is the Analysis Matrix which continues the example with the criteria and their associated weights written across the top of the matrix. (2) The options available are written vertically by criterion. For example, cost is compared for each of the options first, then the other criteria are also compared. A score of 1 to 5 (higher is better) is used

and then the weight is applied. In the first column, a "cost" score of 1 was given to "Steel Stud with Brick Veneer" and then multiplied by the weight of 13 derived from the first matrix. (3) The total score is computed on the right and the various options are ranked. In the case shown here the highest score is 166, and thus the number one choice is "Exposed Concrete Block with Split Face Finish."

CRITERIA MATRIX

Study Title: Exterior Walls									
CRITERIA									
A COST	B MAINTAINABILITY	C AESTHETICS	D PROVEN QUALITY	E HVAC IMPACT	F REDESIGN TIME	G	H	SUM OF SCORES IN BOTH VERTICAL & HORIZONTAL	RANK
A	A1	A3	A2	A3	A4			A ¹³	1
	B	B5	D1	E3	B2			B ⁷	4
		C	D3	C4	C4			C ⁸	3
			D	E3	D5			D ⁹	2
				E	F3			E ⁶	5
					F			F ³	6
						G		G	
							H	H	

To each box under SCORE, be sure to write both the letter representing the PROBLEM AREA and the numeral or cipher representing the WEIGHTING for the choice you feel is most important. Preference weightings:
0=no difference, 1=minor, 3=medium, 5=major

ANALYSIS MATRIX

Study Title: Exterior Walls											
Basic Function: Control Elements/Support Load											
	Desired Criteria ↓	A COST	B MAINTAINABILITY	C AESTHETICS	D PROVEN QUALITY	E HVAC IMPACT	F REDESIGN TIME	G	TOTAL	RANK	
		Weight from Criteria Matrix →	13	7	8	9	6	3			
Concrete Block, Painted		5	2	1	1	2	3		117	#5	
		65	14	8	9	12	9				
Steel Stud with Brick Veneer		1	4	4	4	4	1		136	#4	
		13	28	32	36	24	3				
Steel Stud with Stucco		3	3	3	3	4	1		138	#3	
		39	21	24	27	24	3				
Exposed Concrete Block with Split Face Finish		4	4	4	3	3	3		166	#1	
		52	28	32	27	18	9				
Concrete Block with Stucco Exterior		4	3	3	2	2	3		136	#2	
		52	21	24	18	12	9				

List the best ideas from ranking and comparisons techniques. Determine which one stacks up best against the desired criteria.
Excellent = 5 Very good = 4 Good = 3 Fair = 2 Poor = 1

Justifying a decision to make changes that improve the energy performance or reduce the environmental impacts of a facility requires close attention to the economics of the situation. There are several key economic analysis methods the facility manager should be familiar with and utilize for this purpose, the most important of which is Life-Cycle Costing (LCC). Other analysis tools include Cost-Benefit Analysis and Life-Cycle Analysis (LCA).



Technical Information

Although the names sound alike, LCC and LCA are in fact very different.

LCC analyzes building or facility changes to include amortized system costs, maintenance and insurance costs, replacement costs, energy costs, and other significant costs over the assumed life of the measure or facility. It combines all costs into a net annual cost and then reduces these annual costs to a net total cost, usually the Net Present Value. LCC must be performed by facility managers.

LCA is used to analyze the impacts of a single product, for example a type of paint or a variety of concrete, for its energy and environmental impacts. Sometimes referred to as Product Life Cycle Assessment (PLCA), it is useful for understanding choices between products from an environmental impacts point of view. Unlike LCC, which expresses the outcome in a single monetary unit, PLCA expresses the results in energy units, mass units of pollutants, or other appropriate units. A single, simple representation of the outcome is not really possible. PLCA does not deal with economic issues.



Economic Analysis Tools

There are several readily available tools the facility manager can use to perform a good economic analysis for use in the decision-making process.

1

The National Institute of Standards and Technology's Building Life-Cycle Cost (BLCC) computer program provides economic analysis of proposed capital investments that are expected to reduce long-term operating costs of buildings or building systems/components. It is especially useful for evaluating the costs and benefits of energy conservation projects in facilities, and can be readily adapted for water conservation and other programs. BLCC 4.21 and later versions can calculate annual and life cycle CO₂, SO_x, and NO_x emissions for building energy systems. The Quick Input (QI) program included with BLCC can be used to rapidly set up multiple project alternatives for LCC analysis in a single file. Both software programs are designed to run on IBM-compatible computers and both are updated annually. BLCC is designed to comply with 10CFR436.

2

BLCC, in addition to comparing two or more alternatives, computes the Net Savings, Savings-to-Investment Ratio, Adjusted Internal Rate of Return, and Years to Payback.

General Study Parameters for LCC

- (1) Type of analysis: Federal, military, private sector
- (2) Treatment of inflation: constant or current dollars
- (3) Base Date: the date to which all future costs are discounted
- (4) Service Date: the date at which the facility will be occupied or system put into service
- (5) Study Period: usually the life of the facility or product
- (6) Discount Rate: the investor's opportunity cost or the minimum acceptable return
- (7) Applicable Tax Rates: for private sector analyses

Other Important Parameters for LCC

- (1) Annual O&M costs
- (2) Non-annually recurring O&M costs
- (3) Energy and water quantities and costs
- (4) Salvage value

References

The following programs and resources are available through the FEMP Help Desk and Home Page.

NIST Publications and Tools: The following are available from the National Institute of Standards and Technology (NIST). For ordering information, contact the NIST Inquiries Office, Room A-903 Administration Building, Gaithersburg, MD 20899 (301) 975-3058, or the NIST Office of Applied Economics at (301) 975-6132.

Building Life-Cycle Cost (BLCC) Computer Program, User's Guide and Reference Manual, (NISTIR 5185-2). This is the "NIST Building Life-Cycle Cost (BLCC) program and guide" referenced on the previous page. The FEMP Help Desk at (800) DOE-EREC will provide copies, and information about schedules for training courses offered in various locations throughout the country.

DISCOUNT: A Program for Discounting Computations in Life-Cycle Cost Analyses, (NISTIR 4513). A software program for computing discount factors. Be sure to ask for the latest version.

Present Worth Factors for Life-Cycle Cost Studies in the Department of Defense, (NISTIR 4842-2). A separate version of the report listed above, for DOD analyses.

Videos: Three video training films offering an introduction to FEMP life-cycle costing (LCC) methods are available from Video Transfer Inc.: (1) "An Introduction to Life-Cycle Cost Analysis"; (2) "Uncertainty and Risk"; and, (3) "Choosing Economic Valuation Methods." For ordering information, contact them at 5709-B Arundel Ave., Rockville, MD 20852 or at (301) 881-0270.

Training Programs: *Building Life-Cycle Cost (BLCC) Computer Program* training courses are offered in various locations throughout the country. Contact the FEMP Help Desk at (800) DOE-EREC for information.

Contacts

The FEMP Help Desk at (800) DOE-EREC or FEMP's home page at <http://www.eren.doe.gov/femp>

Society for Environmental Toxicology and Chemistry (SETAC), Pensacola, FL at (904) 465-1500 is a good source of information about Product Life Cycle Assessment (PLCA). The SETAC PLCA methodology is the most widely accepted procedure for determining the environmental impacts of materials or products.

NIST Home Page at <http://www.nist.gov>